

Amendments to the Claims

This listing of claims will replace all prior listings of claims in the application.

Listing of Claims

1.-8. (Cancelled).

9. (Currently Amended) A method for shading and texturing a 3-dimensional computer generated image for presentation of the image on a display, the display consisting of a plurality of elementary areas, said method including the steps of:

supplying data defining a set of surfaces that represent each object in the image;

for each elementary area of the display, based on the surface-defining data, generating a depth value for the object surfaces that may be visible at the elementary area as a function of the distances of the object surfaces at the elementary area from an image plane;

determining translucency values for texture data to be applied to object surfaces at an elementary area to determine whether or not, at the elementary area, the object surfaces are opaque;

for a first opaque object surface at the elementary area, storing the depth value for the surface;

for one or more subsequent opaque object surfaces at the elementary area, for each opaque object surface, comparing the depth value of the subsequent opaque object surface to the stored depth value for the opaque object surface at the elementary area and for which the depth value is stored;
and

between consecutive said steps of comparing depth values, if, in said step of comparing the depth value of the

subsequent opaque object surface to the stored depth value it is determined that the subsequent opaque object surface is closer to the image plane than the opaque object surface associated with the stored depth value, replacing the stored depth value with the depth value for the subsequent opaque object surface;

wherein only after said step or said steps of comparing the depth value of the subsequent opaque object surface to the stored depth value and replacing the stored depth value with the depth value for the subsequent opaque object surface are executed, at the elementary area, rendering the opaque object surface for which, at the elementary area, the depth value is stored.

10. (Currently Amended) The method of Claim 9, wherein said step of rendering the opaque object surface comprises, ~~after said step or said steps of comparing the depth value of the subsequent opaque object surface to the stored depth value and replacing the stored depth value with the depth value for the subsequent opaque object surface are executed, at the elementary area,~~ surface shading and texturing the opaque object surface ~~for which, at the elementary area, the depth value is stored.~~

11. (Previously Presented) The method of Claim 9, wherein:

the image is divided into a plurality of rectangular areas; and

said steps of determining translucency values, storing the depth value for the first opaque object surface, comparing the depth values of the subsequent opaque object surfaces and replacing the stored depth value are performed on a rectangular area by rectangular area basis.

12. (Currently Amended) The method of Claim 9, wherein:
after said steps of comparing the depth value of ~~the~~ a subsequent opaque object surface to the stored depth value and, if said comparison indicates that the subsequent object surface is behind the opaque object surface for which a depth value is stored, the surface defining data for the subsequent opaque object surface is discarded;

after said steps of comparing the depth value of the subsequent opaque object surface to the stored depth value and replacing the stored depth value with the depth value of the subsequent opaque object surface are fully executed for the subsequent opaque object surface, the object surfaces are sorted back to front relative to the image plane wherein the first surface is the opaque object surface; and

after said back to front object surface sorting, the opaque object surface is subjected to shading and texturing based on the data for non-opaque object surfaces forward of the opaque object surface.

13. (Currently Amended) An apparatus for shading and texturing a 3-dimensional computer generated image for presentation of the image on a display, the display consisting of a plurality of elementary areas, said apparatus including:

means for supplying data defining a set of surfaces that represent each object in the image;

means for generating a depth value for each object surface that may be visible at an elementary area of the display based on the surface-defining data as a function of the distance of the object surface at the elementary area from an image plane;

means for determining translucency values for texture data to be applied to object surfaces at the elementary area to determine whether or not, at the elementary area, the object surfaces are opaque;

means for receiving the object surface depth value of a first opaque object surface of the object surfaces ~~at the~~ at the elementary area, and storing the depth value for the first opaque object surface;i

means for receiving, for a subsequent opaque object ~~surfaces~~ surface at the elementary area, the depth value of the subsequent opaque object surface and for comparing the stored depth value of the subsequent opaque object surface to the stored opaque object surface depth value at the elementary area, said means for receiving and comparing the depth value of the subsequent opaque object surface configured to receive and compare the depth values of each subsequent opaque object surface present at the elementary area; ~~and~~

a data overwrite means connected to said means for receiving and comparing the depth value of the subsequent opaque object surface, wherein, for each comparison, if said means for receiving and comparing the depth value of the subsequent opaque object surface determines that the subsequent opaque object surface is closer to the image plane than the opaque object surface for which a depth value is stored, said data overwrite means replaces the stored depth value with the depth value for the subsequent opaque object surface; and

means for rendering the object surface for which, at the elementary area, the depth value is stored, wherein said means for rendering is configured to take place only when said means for rendering receives an indication that said means for receiving and comparing the depth value of the subsequent opaque object surface has completed the comparisons for the subsequent opaque object surfaces.

14. (Currently Amended) The apparatus of Claim 13, wherein said means for rendering comprises ~~further including~~ means for surface shading and texturing the object surface for

which, at the elementary area, the depth value is stored,
~~wherein said means for said surface shading and texturing is
configured to only perform the surface shading and texturing
when said means for surface shading and texturing receives an
indication that said means for receiving and comparing the
depth value of the subsequent opaque object surface has
completed the comparisons for the subsequent opaque object
surfaces.~~

15. (Previously Presented) The apparatus of Claim 13,
furthering including:

means for discarding surface data for discarding the
surface data for the object surfaces behind the most forward
opaque object surface;

means for sorting the object surfaces back to front
relative to the image plane, said sorting means configured to
sort the object surfaces after said means for receiving and
comparing the depth value of the subsequent opaque object
surface, compares the depth values of each subsequent opaque
object surface at the elementary area;

shading and texturing means for shading and texturing the
opaque object surface at the elementary area based on the
object surface data for the object surfaces located forward of
the opaque object surface.

16. (Previously Presented) A method for shading and
texturing a 3-dimensional computer generated image for
presentation of the image on a display, the display consisting
of a plurality of elementary areas, said method including the
steps of:

supplying data defining a set of surfaces that represent
each object in the image;

for each elementary area of the display, based on the
surface-defining data, generating a depth value for the object

surfaces that may be visible at the elementary area as a function of the distances of the object surfaces at the elementary area from an image plane;

based on the depth values for the object surfaces, at each elementary area, sorting the object surfaces in front to back order from the image plane;

after said sorting step, at each elementary area, for the sorted object surfaces, starting with the most forward object surface determining whether or not the object surface is completely opaque,

if, it is determined that an object surface is completely opaque at an elementary area:

at that elementary area, discarding the surface-defining data for the object surfaces behind the opaque object surface;

at the elementary area, applying shading and texturing to the opaque object surface.

17. (Previously Presented) The method of Claim 16, wherein:

after said step of discarding the surface-defining data for the object surfaces behind the opaque object surface, sorting the object surfaces from back to front relative to the image plane; and

after said step of back to front surface sorting, performing said step of shading and texturing the image at the elementary area based on the non-completely opaque surface data for the surfaces located forward of the completely opaque surface.

18. (Previously Presented) The method of Claim 16, wherein:

said step of determining whether or not at an elementary area an object surface is completely opaque is performed by:

obtaining data for the object surface defining the texture of the object surface including data describing the opacity of the object surface; and

based on the texture-defining data for the surface at the elementary area, determining whether or not, at the elementary area, the surface is completely opaque; and

said step of determining whether or not, at an elementary area, an object surface is completely opaque is not performed for surfaces after the most forward surface that is completely opaque.

19. (Previously Presented) The method of Claim 16, wherein:

the image is divided into a plurality of rectangular areas; and

said steps of sorting the object surfaces front to back and determining whether or not, at an elementary area, an object surface is completely opaque are performed on a rectangular area by rectangular area basis.

20. (Currently Amended) An apparatus for shading and texturing a 3-dimensional computer generated image for presentation of the image on a display, the display consisting of a plurality of elementary areas, the apparatus including:

means for supplying data defining a set of surfaces that represent each object in the image;

means for generating a depth value for the surfaces of each object that may be visible at each elementary area of the display, based on the surface-defining data, said means for generating a depth value ~~generating depth values~~ for the object surfaces as a function of the distances of the object surfaces at the elementary area from an image plane;

means for sorting the object surfaces that may be visible at an elementary area in a front to back order from the image plane based on the depth values for the object surfaces;

means for determining whether or not an object surface at each elementary area is completely opaque, wherein said means for determining whether or not an object surface is completely opaque is configured to receive the object surface defining data for the object surfaces in the sorted front to back surface order based on the sorting performed by said means for sorting the object surfaces;

means for discarding the surface-defining data for the object surfaces behind the first determined completely opaque object surface at the elementary area; and

means for applying shading and texturing to the first determined completely opaque object surface at the elementary area.

21. (Previously Presented) The apparatus of Claim 20, wherein:

means for sorting the object surfaces from back to front relative to the image plane is provided that receives the surface defining data after the surface-defining data for the object surfaces behind the opaque surfaces are discarded; and

said means for applying shading and texturing to the completely opaque object surface performs the shading and texturing for each elementary area based on the non-complete opaque surface data for the surfaces located forward of the completely opaque object surface.

22. (Currently Amended) The apparatus of Claim 20, wherein said means for determining whether or not at an elementary area an object surface is completely opaque is configured to: obtain data for the object surface defining the texture of the surface including data describing the

opacity of the surface; and based on the texture-defining data for the surface at the elementary area, determining whether or not at the elementary area the object surface is completely opaque.